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# The Evolution of Problem-based Learning in Medical Universities

## 医科大学におけるPBLの発展

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English

### **Abstract**

This paper examines how PBL has developed over the past forty-four years since its introduction into the curriculum of McMaster University's School of Medicine, Canada, and how it has subsequently evolved as it has been incorporated into the curriculum of various medical universities worldwide.

**Key words:** problem-based learning, PBL, medical education, medical curriculum

### **1. Introduction**

The trend in medical education worldwide over the last forty-four years has been away from passive, teacher-centered lectures that required rote learning and towards student-centered, task-oriented, active experiential learning that more realistically reflects most doctors' future working environments. This has come about as medical education, struggling to meet the modern day pressures and demands of a rapidly changing world, had reached a new tipping point (O'Dowd, 2009). The previous tipping point occurred over one hundred years ago after Abraham Flexner authored a report entitled "Medical Education in the United States and Canada" published in 1910 that served as the basis for drastic reforms to medical education then that have lasted to the present day. Flexner observed in his visits to medical schools that boring lecture-style education was of little value in medical education, especially when divorced from real-life patient problems. Unfortunately, implementation of Flexner's recommendations in actuality did not produce the type of medical education he envisaged as reform. Rather, the result was the adoption of a formalized, academic, lecture-based, teacher-centered curriculum comprised of a few years of scientific education followed by several years of clinical training in a teaching hospital. This reform also excluded

the social and humanistic aspects of doctors' training, replacing the personable physician with a cold clinician. In addition, the rapid expansion of scientific medical research produced an ever-increasing volume of medical knowledge and new approaches doctors were hard-pressed to keep up with, especially in the era before the Internet. What was also needed was an approach to teaching and learning medicine that promoted self-directed learning for the development of life-long learning skills so essential to effective medical practice when medical knowledge is expanding exponentially.

Problem-based Learning (PBL) was originally developed in response to the criticism that traditional lecture-based teaching and rote-learning methods employed in medical universities were failing to produce graduate doctors fully prepared for the rigors of real-world medicine on patients in clinical settings. Rather than have students passively endure teacher-based lectures that require them to cram massive amounts of medical information in the hope that they can pass snap-shot tests (regardless of their actual competency or ability to use the information) at the end of their programs, the curriculum should provide students with continual, close to real-life learning experiences and the opportunity to actively participate in their own learning. Indeed, PBL was developed to address all these issues being raised about the shortcomings of traditional medical curricula. Whatever shortcomings could be identified in traditional curricula, PBL seemed to provide an elegant solution.

PBL was heralded as a very successful innovation in the first few schools that adopted it, being applauded by both medical faculty and students. This success in different medical schools, both geographically and culturally, gave confidence to other institutions that PBL could be applied universally. Indeed, there were considerable exchanges between the early developers of PBL and later adopters, including visits to universities with established programs and consultations with expert faculty. Such exchanges led to the increasingly successful implementation of PBL programs both domestically and overseas. And once PBL had been introduced successfully in more medical schools, it became a "known" innovation and therefore seemed less of a risk to implement; indeed, as PBL became more widely adopted, medical schools risked being left behind and being regarded as unprogressive.

To understand why PBL has been so successful, and still somewhat controversial, it is useful to examine how it has evolved and how medical schools in various countries have handled both its implementation and development. This paper examines how the teaching methodology called Problem-based Learning has developed over the past forty-four years since its introduction into the curriculum of McMaster University's School of Medicine, Canada, and how it has evolved in various medical universities around the world. It should be noted that an exhaustive description of all PBL programs is outside the scope of this introductory paper; what is presented here is a brief outline of the evolution of PBL along with some description of the salient features of important PBL programs.

## **2. What is PBL**

From its inception, although the basic characteristics and goals of PBL have been well established (Albanese et al., 1993; Barrows, 1994, 1996; Bridges, 1992; Bligh, 1995; O'Dowd, 2005), its nature is somewhat nebulous; it exists but the shape it takes can differ according to where it is at any particular time. Indeed, one of its originators, Howard Barrows (1994), suggested the nature of PBL was malleable in design and execution. And as PBL has globalized and evolved, so has it become more difficult to define. Nevertheless, if we start with the characteristics of how it is structured, PBL can be easily identified; in short, it is a teaching and learning methodology that utilizes the tutorial as its primary vehicle and discovery and cooperation as the principal method of learning. Medical students work together in small groups (tutorials) and are presented with series of broad real-life situations (problems), typically an example patient presentation or scenario. They identify what features of the problem are outside their present knowledge (learning issues) and divide these areas between them. They then research their learning issues, using library and Internet resources to fill in the blanks, and report back to their tutorial group with their findings. This process is overseen by a group tutor who ensures the students stay on track as well as having a role in student evaluation and assessment.

Of course, different schools implement this basic structure to different degrees. For example, some tutorial groups can be “small” (4-6 members) while others have up to 20 students (making real discussion and cooperation difficult). Tutors can be faculty members (both clinical and non-clinical professionals), specially employed professionals from outside the institution, and even the student's peers. Some schools run their entire curriculum focused around PBL and self-directed learning, whereas others have “hybridized” their approach and so may only use tutorial groups as little as once a week. Indeed, most schools with PBL still have some lectures to cover basic materials, but some schools are even more hybridized and maintain their traditional curriculum to varying degrees. Examples of this development will be shown in the following descriptions of PBL program developments in significant medical universities.

## **3. Descriptions of PBL programs**

### **3.1 The beginning: Canada**

The initial concept of modern PBL for medical schools is generally acknowledged (Albanese et al., 1993; Lee & Kwan, 1997; Davis and Harden, 1999) as being first implemented in 1969 at McMaster University's School of Medicine in Hamilton, Ontario, Canada. It took the form of a three-year PBL curriculum that emphasized small-group tutorials, self-directed learning, a minimal number of didactic lectures, and student evaluation that was based almost entirely on performance in the tutorial. The faculty staff that devised this pilot PBL program, starting with 20 medical students, envisioned an instructional methodology based on constructivist assumptions about learning that represented a complete departure

from the formal educational practice of didactic lectures. Constructivism theorizes that “knowledge” is not an absolute but rather is “constructed” by the learner based on activating previous knowledge and interactions with other views. Therefore, if students were given the opportunity to find knowledge for themselves by studying in small groups, contrasting their understanding of that knowledge with others’ understanding, and refining knowledge as more relevant experience is gained, (all of which are done by students in PBL curricula), better learning would result. Indeed, the first report of the faculty education committee, in January 1967, made specific mention of including problem solving in the curriculum; however, it was faculty member Howard Barrows who is credited with developing the more advanced concepts of PBL (Neufeld et al. 1989).

Since the original 1969 PBL curriculum, McMaster has implemented two major curriculum revisions, the most recent of which was in 2005 (Neville & Norman, 2007). The original PBL curriculum sought to integrate both basic science and clinical science into biomedical problems. The second iteration changed the focus to priority health problems. This PBL curriculum was organized around on a list of common medical problems on the basis that an understanding of the management of common conditions was essential for developing clinical competence. The third, and current, curriculum model is referred to as COMPASS: concept-oriented, multidisciplinary, problem-based, practice for transfer, simulations in clerkship, and streaming. In this concept-based system, emphasis is placed on the logical sequencing of both the curriculum concepts and the body systems (Neville & Norman, 2007).

Even in its early stages of growth and evolution, it was becoming clear that PBL was becoming both difficult to define and subject to design alteration to better suit individual institutional parameters. Barrows was interested in seeing different types of PBL develop, but his attitude was if a program was more teacher centered than student centered, it wasn’t PBL.

### **3.2 Crossing the Atlantic: The Netherlands**

Taking its cue from the reported success of McMaster’s PBL program, the Medical Faculty of Maastricht University in the Netherlands, newly opened in 1974, was the first European university to fully implement PBL in its entire curriculum. This total approach also included a novel development to PBL in that the traditional array of medical disciplines and majors were dropped in favor of a thematic format by which a variety of topic themes were introduced to students via the case descriptions and problem sets. As with regular PBL, students were to analyze each case problem in their small tutorial groups (8-10 members) meeting with their tutor twice a week, discover what they didn’t know and formulate learning issues to elaborate on at their next tutorial meeting. Although skills training and practice sessions were also part of the schedule, the majority of their study time was apportioned to independent self-study. This Maastricht approach also proved to be highly successful and was quickly adopted into other departments;

in each case, the PBL model was altered in some way to make a better fit to the distinct needs of the new environment.

This Maastricht model of PBL is now well known and widely disseminated to other institutions. For its part, Maastricht University has developed its website to bring together PBL resources for public access to continue this evolution of PBL.

### **3.3 Going south: The United States of America**

The touted success of PBL soon reached medical schools in the United States, some of which took a more cautious approach to such an innovation. While some, such as Michigan State University, were working on developing their own PBL curricula, others like the University of New Mexico decided in 1979 to offer an abridged concurrent PBL program. However, the introduction of PBL programs in the USA was greatly accelerated by the release of a report sponsored by the Association of American Medical Colleges in 1984 that recommended significant changes be made to the delivery of medical education, including the promotion of independent learning, emphasis on problem solving skills, reducing scheduled lecture hours, and evaluation that reflected the students' ability to learn. This report opened the doors of American medical colleges to adopt PBL at a more rapid pace as well as to tailor their PBL programs to their individual needs. One such example is the New Pathways Program developed at Harvard University. Other universities took the more arduous path of reformulating their curriculums to implement PBL, as much as possible, as envisioned by its creators; the University of Hawaii was one of these.

### **3.4 University of Hawaii, John A. Burns School of Medicine**

PBL is the primary educational methodology utilized at the University of Hawaii John A. Burns School of Medicine (JABSOM). JABSOM adopted its PBL curriculum in 1989, modeled after the successful program at McMaster University in Canada. Their MD Program is a four-year curriculum that includes an initial two-year pre-clinical portion followed by two years of clinical activities in hospitals and clinics. The pre-clinical years are divided into eight instructional units, six of which are organized around PBL tutorials. Within each of these segments of the curriculum, students can look forward to active and engaging PBL tutorials, supplemented by lectures, labs, standardized patients, and advanced simulation experiences.

There is a strong emphasis on student-directed learning in their small-group discussions of clinical cases. This also acts as the stimulus for the development of problem-solving and life-long learning skills. In addition, students are expected to build their team-learning skills and take an active role in their learning. Indeed, JABSOM students and graduates have expressed tremendous satisfaction with their PBL experience, with example feedback posted on their website.

JABSOM has earned a well-deserved reputation for its commitment and expertise in utilizing problem-based learning in medical student education. Medical schools from the mainland USA, Japan, Korea, and Taiwan have requested that JABSOM help them develop their own PBL curricula; JABSOM also provides PBL training workshops for both overseas medical students as well as overseas faculty and tutors.

### **3.5 Down Under: Australia**

The medical program at the University of Queensland School of Medicine (UQSM) is a four-year, graduate entry program that features a well-established PBL curriculum. The first year of the medical curriculum has an enrolment of approximately 270 students, divided into 26 PBL groups, with three teaching terms of about 11 weeks each. The small-group PBL tutorials are supported by a combination of lectures, laboratory classes, clinical skills sessions, expert tutorials and symposia as part of an intense weekly program from first year onwards. Mondays and Thursdays are dedicated PBL group learning days. The program facilitates integration of evidence based theoretical and clinical knowledge driven by the PBL philosophy.

In my most recent surveys (starting in 2005) of how PBL was conducted at UQSM, my attention has been focused on the tutors of the PBL program. Their PBL program employs a range of tutors: full-time academic staff, postgraduate students and others employed on a casual basis. Although tutors all have medical, basic science or educational qualifications, the majority has expertise in at least one of the basic sciences, reflecting the dominant focus of the First Year curriculum. All tutors are specifically trained in PBL before appointment to a student group and may teach up to three terms each year. Tutoring in PBL has two components: facilitation skill and content knowledge. It may be expected that students would consider the principal strength of clinically qualified tutors to be their greater relevant content knowledge. In contrast, the principal strength of non-clinically qualified academic staff to the PBL process would be the facilitation skills derived from (often extensive) teaching experience.

### **3.6 Asia: Republic of Korea**

Kyungpook National University (KNU) School of Medicine in Daegu, Republic of Korea, has a traditional medical curriculum that incorporates a PBL component. PBL was adopted as part of a reform of medical education that had support both internally and externally. At KNU, PBL tutorials are designed to run concurrently with a traditional medical curriculum. It was implemented as an essential 2-credit-hour course in 1999 to the freshmen class throughout the year after years of preparation that included a visit to McMaster University School of Medicine in Canada in May 1994. A pilot PBL program for freshmen only ran from 1994 to 1996 and was extended to sophomores in 2000 and to juniors in 2001 (Chang et al.,

2001).

Although initial excitement over expectations gave way to some confusion and disappointments from faculty members and students, the majority opinion of both parties on continuation of PBL for sophomores and juniors was positive. To further develop it, twenty students and 4 faculty members visited JABSOM (John A. Burns School of Medicine) in Hawaii in 2007. Since then, an average of 6 students visit Hawaii each winter to participate in PBL tutorials and expand their experience.

Now, PBL tutorials for the second year class (2 PBL tutorials per week, 6-7 students per group, one case per 2 week, about 8 cases per semester) are organized and operated by the Department of Medical Education. PBL tutorials for the 1st, 3rd, 4th year classes are run by the individual course units or departments. All tutors are employed internally and students assess their performance.

Survey data of KNU students' perception of PBL vs. lectures has been analyzed (Chang et al., 2001). It showed higher satisfaction score with lectures in three domains out of eleven: necessity, effectiveness, and acquisition of medical knowledge. However, students were more satisfied with PBL in six domains: long-term memory, communication skill, clinical reasoning, self-directed learning, cooperation, and evidence-based learning. There was no difference in satisfaction with lecture and PBL in two domains: motivation, and integrated understanding of medical knowledge.

### 3.7 Singapore

In 1997, the then Dean of the Faculty of Medicine at the National University of Singapore (NUS), Professor Tan Chuan, initiated a major PBL reform of the undergraduate medical curriculum (Problem-Based Learning Committee NUS, 2012). PBL was to be introduced with the overall aim of enhancing the quality of education, providing a more holistic experience for medical students, and promoting self-directed learning skills needed to develop the long-life learning skills necessary in future medical careers. In August 1999, PBL was first implemented in Year I of the NUS medical course, not merely as a teaching method but also as an innovative educational strategy to foster self-directed learning; in August 2000 implementation was carried over to Year II, with the intention of continuing on a yearly basis to Year V.

Initially, implementation by the academic staff was somewhat half-hearted. In addition, PBL was only allotted for 20% of the overall curriculum time. More seriously, numerous 'teething problems' were experienced right from the start; these problems were attributed to the shift from the comfort zone of the passive 'transmit-receive' type teacher-student relationship to the much more active-interactive learning environment of tutorials. Another issue was teachers who did not feel confident enough tutoring clinical problems; indeed, some teachers felt that as problem cases were not related to their particular field of expertise they would have to sacrifice their time doing extra preparation for tutorials. Further tutor problems arose, including tutors who still felt compelled to teach-and-tell rather than to guide, tutors



lacking in PBL tutorial skills, tutors who were skeptics and critics, and those who simply lacked enthusiasm for change.

As a result, the implementation of PBL failed to meet NUS's high expectations as it ran head long into the deeply entrenched traditional medical curriculum (founded in 1905). The main problem was that while the Administration was keen for reform, both faculty and students lacked the impetus for such drastic change. Many students in particular did not seem able to come to terms with the new demands of the approach; the result was the suspension of radical changes and the implementation of a hybrid approach that reintroduced lectures and put students back squarely in their comfort zone. It is interesting to note that the NUS Centre for Development of Teaching and Learning (CDLT) published several articles in support of the PBL reform, including one entitled "*Can Asians do PBL?*" (the answer was no, maybe, but hopefully yes) that expressed optimism for PBL in its future development there (Khoo, 2000).

#### **4. Discussion**

The widespread acceptance and implementation of PBL programs in medical universities around the globe certainly indicated that traditional medical education was in dire need of change. With the initial impetus for change coming from Canada, medical educators in other countries keenly embraced curriculum change that offered a novel solution to remedying what many came to perceive as an outmoded system for training doctors for the modern era. At the same time, as can be gleaned from the descriptions given above, implementation of a PBL curriculum has not been uniform nor free from local considerations of what needs to be changed, how much, and for whom. Implementation in different countries meant different ideas and different emphasizes would shape how PBL evolved to meet their stated educational goals and objectives; fortunately, it was never meant to be a one-size-fits-all innovation.

Indeed, as can also be seen in the descriptions above, most institutions have striven to place their own individual stamp on PBL to reflect what educators believe to be their best approach to producing the doctors required by their respective societies. The critical PBL elements most commonly focused on include the following; (1) how the required knowledge base is organized and structured into units for PBL tutorials, (2) how much time is devoted to tutorials and self-study, (3) the case studies used for discussion and learning, (4) who tutors the students and how they are recruited, and (5) evaluation. It is important to remember that the goal of PBL is not to simply give students all knowledge about every medical topic, because that is an unobtainable goal for any educational approach, but rather to help students develop the skills beyond rote memorization, as outlined by Bloom (1956) and described in O'Dowd (2007, 2009).

Of course, not every implementation of PBL has yielded the high degree of success often expected by stakeholders. It is not that PBL itself is at fault, but rather the implementation of change has been



fumbled, usually due to institutional factors such as insufficiently preparation of teachers, students, facilities, resources, tutors and administrative staff prior to implementation, that implementation was ineffectual (breeding confusion and discontent rather than education), or that over expectation lead to disappointment, critical review, and even abandonment.

On a more positive note, where implementation has been regarded as effectual, PBL has evolved to build success. In particular, by taking note of stakeholder feedback to address or reduce perceived weaknesses while enhancing opportunities for students to build needed skills and knowledge base, PBL programs build in progress, as opposed to the static, non-progressive nature of didactic lectures.

## 5. Conclusion

Forty-four years since its epoch-making introduction into the curriculum of McMaster University's School of Medicine in Canada, PBL can be said to have made an indelible mark on a generation of medical doctors worldwide and the universities that graduated them. Over that time, PBL has been constantly evolving at the institutional level to meet the demands of students, faculty, and medical colleges in various countries around the world while still retaining its easily recognizable features. And even though some medical students, as well as some medical faculty, have struggled to cope with the changes PBL required of them, it has developed to the point where new approaches are now being built on its foundation and a new epoch in medical education is on the horizon. Indeed, looking forward also means looking outwards to see what is evolving in PBL programs outside our own.

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